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Quarterly Report

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Contract Number: DTPH56-05-T-0001
Prepared for: United States Department of Transportation
Pipeline and Hazardous Materials Safety Administration
Office of Pipeline Safety

Project Title: "Understanding Magnetic Flux Leakage (MFL) Signals from Mechanical Damage in Pipelines"

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For quarterly period ending: December 31, 2007

Progress to Date

The objective of this project is to understand the origin of Magnetic Flux Leakage (MFL) signals from dents, with the ultimate goal being to accurately characterize dents from MFL field inspection data. MFL dent signals arise from both the dent geometry as well as the residual stresses surrounding the dent. In this project, experimental and finite element modelling techniques are used to separate and understand both stress and geometry contributions to the MFL signals.

Work conducted prior to the initiation of this contract by the Queen's University Applied Magnetics Group involved examination of MFL signals from circular dents. The first year of the current US DOT PHMSA cofunded effort involved extending this study to include "elongated" dents; specifically, dents having a 2:1 length to width aspect ratio. All prior first year work of the study involved "laboratory" dents produced in plates using a compression machine at Queen's University. The second (current) year of the PHMSA co-funded effort involves extending the study to examine dents in pipeline samples. Sections of dented pipeline will be provided by Gaz de France, who employ a specialized 'calibrated backhoe' unit (termed a 'pipe aggression rig') designed to introduce realistic dents and gouges into pipe sections. As part of the second year of this effort, Queen's personnel will be travelling to the Gaz de France facilities in St. Denis, France to make MFL measurements on a number of pipeline sections containing well-characterized dents and gouges.

Research during the previous quarter (July-Sept 2006) involved preparing and upgrading the MFL measuring equipment to make it more robust and portable for the trip to Gaz de France facilities, and to modify it to accommodate the larger geometry and curved nature of the pipeline sample coupons. In addition, the Infolytica MagNet magnetic modeling software license was renewed and considerable work was done to determine how best to build pipeline dent models using MagNet. Gaz de France also conducted stress FEA to provide the necessary inputs for Queen's magnetic FEA models.

The present quarter (Oct-Dec 2006) involved shipping equipment, and traveling to the Gaz de France research facility in St. Denis, France to make measurements on samples containing plain dents. Three members of the Queen's Applied Magnetics Group conducted the measurements, which produced successful results. In addition to the experimental work, further work was done using the Infolytica MagNet software package to model plain dents (dents without gouges) in samples having a pipe geometry.

A summary of the tasks conducted this quarter is given below:

Task 6.5 (Item 24) – Modelled MFL signals from plain dents in samples having pipe geometries.

Task 6.6 (Item 25) – Measurement of MFL patterns around plain dents in pipeline sections (at the Gaz de France facility)

Task 4 (Item 26) – Documented quarterly activities and submitted quarterly status report to DOT.

Payable Milestones

The following payable milestones were completed during this reporting period:

- Modelling of MFL signals from plain dents in pipeline geometries (Item No. 24)
- Measurements of MFL patterns around plain dents in Gaz de France pipeline samples (Item No. 25)
- Seventh quarterly report submitted (Item No. 26)